# Zone Guide for Pedestrian Safety

U.S. Department of Transportation
**National Highway Traffic Safety Administration**
**Federal Highway Administration**

# Introduction

Public officials are constantly on the lookout for ways to make the nation's roadways safer for walkers. They seek out or create new ideas in a variety of areas--engineering, enforcement, legislation, training and public education. With increasingly scarce funds, however, it is simply not possible for them to implement many of these ideas if they must be applied to an entire community.

Now, there's a better way. Just as communities can efficiently mount crime prevention programs by focusing them in high crime areas, they can also efficiently concentrate pedestrian safety improvements by carefully selecting where they are applied. To do this, they need to be able to identify small land areas (or *zones*) where these improvements will reach a large number of the pedestrians whose crash risk is to be reduced.

This guide describes what zoning is and explains how to design and use *pedestrian safety zones* to increase the efficiency and effectiveness of pedestrian safety programs. The guide also provides a brief description of a recent pedestrian safety study that made successful use of the pedestrian safety zone process.

### What is zoning?

$$\boxed{\text{Efficiency} = \frac{\%\text{ of problem addressed}}{\%\text{ of land area covered}}}$$

The zone process provides a systematic method for targeting pedestrian safety improvements in a cost effective manner. Zoning identifies a subset of a jurisdiction containing as much of the pedestrian problem of interest in as little land area as possible. Specifically, it involves defining relatively *small* geographic areas where a relatively *large* proportion of the problem occurs. The aim is to achieve the highest possible *efficiency*, which is expressed as the ratio of the percent of the problem addressed to the percent of the land area covered. A ratio of 3 to 1 or more is the target and suggests that the zone process will yield a meaningful benefit.

Once zones are defined, pedestrian safety programs can be focused in them with greatly increased efficiency. Also, by concentrating on the zones, it is often possible to implement certain activities such as engineering improvements and distribution of giveaways (bookmarks, flyers, etc.) that would simply be too expensive to introduce on a city-wide, county-wide or other large-scale basis.

There are two main benefits of zoning:

- Efficient delivery of the program because it is carried out where a majority of the problem or the target audience exists.
- Efficient use of funds since zoning permits activities that would be prohibitively expensive if applied to an entire community.

### Is zoning new?

The concept of zoning isn't really new. For years, programs for school-aged children have been applied in schools because that is where children routinely congregate and where a large number of them can be reached in an efficient and cost effective manner. In addition, over the years highway safety planners have created pin maps of crashes and other events in order to determine where the events occur and to apply improvements where they are needed. What is new is the orderly process for selecting zones in a community that is described in this guide. This process will:

- *Maximize* the size of the target population reached and
- *Minimize* the land area covered.

## Defining Zones

Zoning is really quite simple. The first step involves selecting the crash problem on which the zones will be based and ensuring the availability of any needed data. The measure is then mapped, and zones are defined.

**Steps in Defining Zones**

***Step 1. Select the crash problem***
***Step 2. Map the pedestrian crashes***
***Step 3. Define zones***
***Step 4. Calculate efficiency measure and select final zones***

### Step 1. Select the crash problem

The first step is to pick the pedestrian crash problem that the community wants to address. For example, are there excessive pedestrian crashes involving young children, working adults or, maybe, the elderly? Is the problem one of alcohol or drug use by the pedestrian?

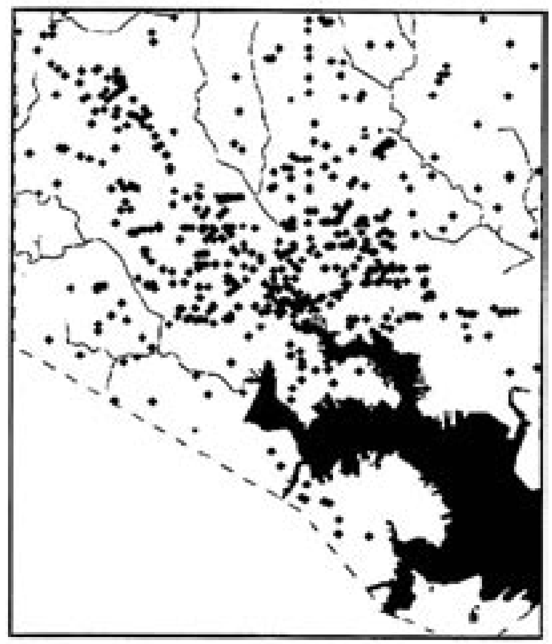
As good as zoning is, not every problem can benefit from it. A zone approach is appropriate when ***all*** of the following conditions exist:

- Crash data needed to define the zones are available.
- There are sufficient data to produce a stable map.
- The pedestrian crashes cluster in some way.

Pedestrian programs are often directed toward specific age groups or toward a specific status of the victim (for example, using alcohol or drugs). A community using zones, therefore, would have to ensure that age and any necessary status data on the victim are present in the available state or local crash files. If not, the needed data must be obtained--likely from police crash reports.

In order to ensure a reasonably stable measure, experience has shown that a minimum of one year's data or at least 100 crash records should be available for establishing pedestrian safety zones. If 100 records for the crashes of interest are not available for a given year, additional whole years of data should be added until at least the recommended minimum number is reached (data for full years are desirable in case there are any seasonal effects). Obviously, the more crash records that are available for any given year, the more stable the zone definition is likely to be.

### Step 2. Map the pedestrian crashes



The pedestrian crashes of interest can be mapped either manually or by a computerized mapping system, often called a geographic information system (GIS). The choice depends on the number of crashes available and/or the availability of a GIS program. There are several commercially available GIS programs that are designed to run on a personal computer.

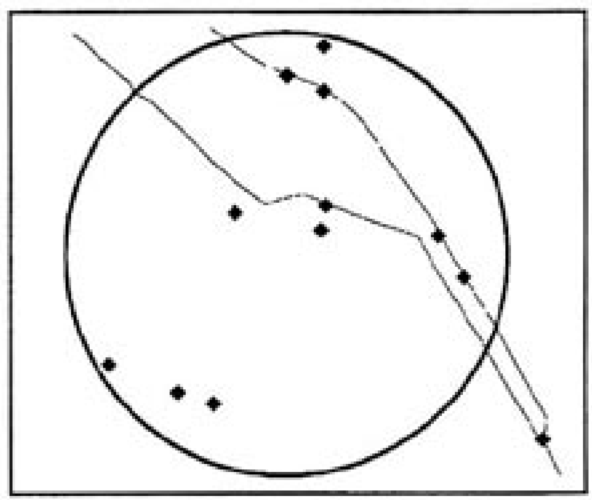
Computerized mapping is obviously more efficient in establishing the correct location of each event. It also permits flexible analysis of the created zones by any number of other variables available in the data. Thus, for example, the data can be analyzed by the full range of variables maintained in a police report (time of day, day of week, etc.) if these records are entered into the computer and maintained with the location information. Maps can be created to show the crashes not only of several target groups (for example, children, working adults and elderly pedestrians) but also of various subgroups of victims or crash circumstances (for example, elderly males or nighttime crashes).

In general, mapping of up to 150 crashes, although tedious, can be accomplished manually. A large map of the area is required, and entry of any data subsets of interest must be planned prior to the start of the mapping. For example, if crash types are of interest, some method such as color coding would be needed to differentiate different crash types of interest. Separate maps might be needed to display different subsets of data. If the residence of the crash victim is also plotted, a means of associating the residence location with the specific crash location is needed.

### Step 3. Define zones

A visual examination of the resulting map will show whether the pedestrian crashes of interest cluster in any areas of the city. If no clustering is apparent, that is, the map shows that the incidence of crashes for any given target group is spread essentially randomly, the problem may *not* be "zonable" for that community using the definitions suggested here.

Most pedestrian crash targets will show some clustering and some dispersion throughout a land area. Therefore, a systematic approach to identifying zones is required. The first steps are to select an initial shape for the zones and to define the target rate, that is, the number of events that must fall in an area for it to be defined as a zone. The approach suggested is to search first for circular zones, then to search for linear zones, then to examine the zones to determine if their shapes need refinement.



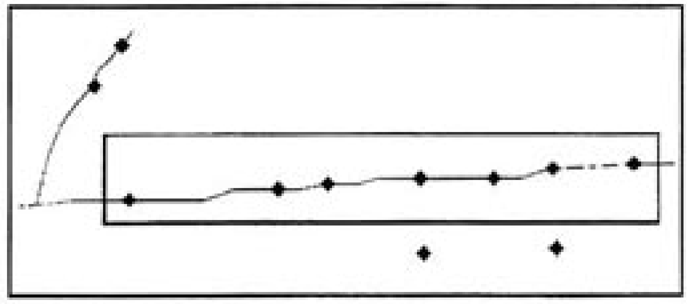
✓ **Search for circular zones.** A circle is an easy area to work with when defining a zone. Since research has shown that most pedestrian crashes occur within one mile of the victim's home or work place, a circular zone with a radius of one mile was adopted for initial "zoning" studies involving pedestrians. A land area of one-mile radius (just over three square miles) is a manageable area in which to concentrate program activities.

A target rate for the events of interest must also be defined before zones can be selected. This rate is the minimum number of crashes that must occur in the circular area in order for the area to be considered a zone. The rate chosen must be high enough to make it worthwhile to mount program activities in the defined area. This rate depends on the size of the sample of crash reports available, how much the crashes cluster and the overall land area of the community.

It is recommended that the analysis start with a target rate of 10 crashes per zone as a minimum. This is a good value if the total annual size of the crash problem being zoned is on the order of 200 or less. If the annual number of crashes is higher, the target rate should be adjusted upward as necessary. For example, if the total number of crashes mapped was 400, a target rate of 20 crashes per zone might be more reasonable. Since the aim of zoning is to select a small land area that will encompass a large number of the target measures, the actual value is less important than the process of looking for clusters.

The individual zone definition process can be initiated for manual maps by simply creating an acetate with a one-mile radius circle and moving it over the map, examining clusters inside the circle and counting the events in the clusters. The same process can be accomplished with a GIS program by defining a circle with a one-mile radius and dragging it over the computerized map with a mouse.

✓ **Search for linear zones.** Most programs targeted at crash reduction will include activities that can be applied to road segments as well as circular areas. Therefore, the map should also be examined for high frequencies of pedestrian crashes that occur along a single strip of roadway. For an annual crash rate on the order of 200, those roadway segments where six or more crashes occur in a two-mile segment should be identified as linear zones. Again, this rate can be adjusted as necessary if the annual crash rate being examined is higher.



✓ **Create final zone shape.** The defined circular and linear zones should be examined to determine if efficiency might be improved if they were merged or their shapes changed. For example, circular zones that are contiguous may be more useful if they overlap or are combined into a rectangular or polygon shape if many crashes occur just outside the zones. It may be wise to reduce the size of a circular zone or change its shape if most of the events within it cluster near the center. It may be better to add or delete a block or two to keep a neighborhood intact within a zone. It may also be necessary to revise the zone shape for a specific program activity. For example, it is easier to define the postal addresses of the zone boundaries of a square or rectangular zone than a circular one. This might be necessary if part of the program is to mail or deliver materials to each residence in a zone.

### Step 4. Calculate efficiency measure and select final zones

Finally, for all the zones combined, the percentages of both crashes and land area covered should be calculated in order to determine program coverage efficiency. If the ratio of the percent of the problem addressed to the percent of the land area covered in the zones is much less than three, the zones may need to be reexamined to try to improve their efficiency. An efficiency ratio of three to one or higher (for example, 60% of the crashes of interest in 20% of the jurisdiction's land area) will almost certainly permit the application of countermeasures locally within the zones that would be prohibitively expensive if deployed jurisdiction-wide. Ultimately, if this ratio cannot be made greater than two, it may be wise to declare the particular problem under study as "non-zonable."

In *defining* pedestrian safety zones, therefore, the following two questions are addressed:

- Do the crashes of interest cluster in some way?
- Does the use of the defined clusters provide enough concentration of the problem to yield increased efficiency and make it possible to use locally deployed countermeasures?

If the answer to either of these questions is negative, the program as planned may not be zonable for that community.

## Using Zones

Once the zones are defined, they must be examined to determine how they can be used. The problems and resources of each zone need to be identified. Activities to counter the problems need to be selected or developed. The practicality of implementing each countermeasure in the zones needs to be determined. Finally, program activities must be implemented and monitored.

**Steps in Using Zones**

***Step 1. Evaluate zones and identify resources***
***Step 2. Select program activities***
***Step 3. Implement program activities***
***Step 4. Monitor program activities***

### Step 5. Evaluate zones and identify resources

The first step here is to review each zone to assess the pedestrian safety problems that exist and the resources that are available to help solve the problem of interest. The effort should start with a review of the police report for each zone crash to determine the nature of the crash and any factors that might have caused it. A drive- or walk-through should then be made of each zone to identify areas where engineering improvements can provide pedestrian safety benefits and to identify resources that can be used for public education. A video of the drive-/walk-through can be an invaluable aid in documenting problem areas and available resources.

Use of a checklist during the walk-through is also recommended. The field checklist should capture information in the following four main areas:

- *Search limitations*--anything that prevents the driver and pedestrian from seeing each other, such as parked cars, tree branches, street furniture, inadequate lighting, etc. The failure of the driver and pedestrian to see each other is by far the largest cause of pedestrian crashes.

- *Potential or observed conflicts*--any conflict between vehicles and pedestrians, such as vehicles that are too close to pedestrians when the vehicles are making right or left turns. Such conflicts can be good predictors of pedestrian safety problems.

- *Negative behavioral indicators*--errors made by either the driver or pedestrian, such as the pedestrian entering the street without searching or the driver proceeding without searching. These negative behaviors can indicate unsafe conditions for pedestrians.

- *High risk factors*--existing factors that can affect the safety of the pedestrian in the roadway, such as high vehicle speeds or signals that provide inadequate time for the pedestrian to cross the street. These factors can increase the likelihood that a crash will occur.

**Pedestrian Safety Zone Field Survey Checklist**

Location: ____________________

Accident History: Frequency: ________ Types: ____________

Date of Review: ____________ Reviewer: ____________

**SEARCH LIMITATIONS**

| Search Limitation | Driver | Ped |
|---|---|---|
| Parked cars | | |
| Unusual amount of moving traffic to obscure vision during crossing | | |
| Roadway curvature | | |
| Terrain | | |
| Vegetation | | |
| Unusual sun glare | | |
| Insufficient building setback | | |
| Moveable roadside items, e.g., street furniture | | |
| Fixed roadside items, e.g., signal control boxes, signs | | |
| Inadequate roadway lighting | | |

**POTENTIAL OR OBSERVED CONFLICTS**

| Conflict Type | Observed | Potential |
|---|---|---|
| Pedestrian walks too close to a vehicle - NEAR SIDE | | |
| Pedestrian walks too close to a vehicle - FAR SIDE | | |
| RIGHT TURN vehicle (on green) too close to pedestrian | | |
| LEFT TURN vehicle too close to pedestrian | | |
| RIGHT TURN ON RED vehicle too close to pedestrian | | |

**NEGATIVE BEHAVIORAL INDICATORS**

- INADEQUATE PED SEARCH (peds enter roadway without searching) ☐
- INADEQUATE DRIVER SEARCH (drivers proceed without searching) ☐
- ABORTED CROSSING (return to curb after both feet in roadway) ☐
- CROSSING AGAINST LIGHT (entry and exit from roadway against signal) ☐
- SMALL GAPS (accepting gaps which require rapid crossings) ☐
- LEAVING CROSSWALK (crossing starts or ends outside of an available crosswalk) ☐
- CROSSING IN FRONT OF A BUS ☐
- VEHICLE OVERTAKING (ped crosses in front of stopped traffic - Multiple Threat) ☐
- RUNNING (entry or crossing while running or obviously moving faster than normal) ☐
- SHORT TIME EXPOSURE (e.g., appearance from behind parked cars) ☐
- RETREAT (momentary reversal in pedestrian direction of travel) ☐

**HIGH RISK FACTORS**

**Travel Conditions:**

HIGH VEHICLE SPEEDS ☐ HIGH PED VOLUME ☐

HIGH VEHICLE VOLUME ☐ POOR SURFACE (danger of falls) ☐

**Signal Conditions:**

TIMING TOO SHORT ☐ TIMING TOO LONG ☐

BAD SIGNAL DESIGN ☐ BAD SIGNAL INSTALLATION ☐

PED CAN'T SEE SIGNAL ☐ DRIVER CAN'T SEE SIGNAL ☐

**Land Use/Characteristics:**

BARS/PACKAGE STORES ☐ OLD AGE FACILITIES ☐

PERSONAL DANGER ☐

A summary of all these observations will help provide the basis for selecting or developing program activities for each zone.

While conducting the on-site analysis, observations and discussions with people in the defined zones will also provide answers to questions such as the following:

- Does the target population reside there, work there, visit there? Are there many members of the target population visible in the zones? What do census data say?
- Are there existing resources in the zones that can be used to reach the target population, such as:
  - ✓ Businesses
  - ✓ Senior centers/youth organizations
  - ✓ Clubs/sports leagues
  - ✓ Medical facilities
  - ✓ Homeowner's associations
  - ✓ Libraries
  - ✓ Churches/synagogues
  - ✓ Schools
  - ✓ Billboards
  - ✓ Stores
  - ✓ Police/fire stations

■ Are there any obvious factors that are causing the problem that may be relatively easy to change? Good countermeasure ideas often arise from an "immersion" in an area that is experiencing a problem.

## Step 6. Select program activities

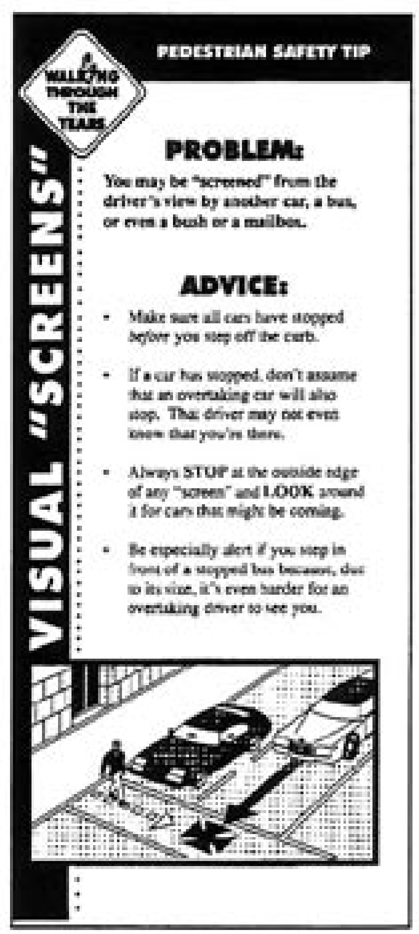
A consideration of each program activity and how it will be applied should accompany zoning plans. Some activities aren't helped by the zone process. For example, television or radio public service announcements (PSAs) cannot typically be targeted to specific areas (unless a zone were to encompass an entire television or radio market). If used, therefore, PSAs would serve as *supporting* not *primary* activities for in-zone pedestrian program activities.

Basically, activities that can be applied in defined, small areas are best suited for zoning. As examples, these include:

■ Most types of engineering improvements such as new signs or signals, signal timing changes, cleaning up visual clutter, installing parking setbacks, installing/refreshing crosswalks, improving roadway lighting, etc. Traffic calming techniques are also particularly well suited for application in zones that have a defined need for slower vehicle speeds.

■ Direct distribution of materials (posters, flyers, etc.) to homes, businesses, libraries, homeowner's associations, senior centers, clubs, medical offices, etc. This type of distribution has been shown to be very effective, but it is also costly if the area to be covered is large. By zoning the problem and distributing materials only to the zones, a limited media budget can be made far more effective.

  Since linear zones by definition include only a segment of one roadway, a few parallel roads (within one-quarter to one-half mile) can be added to each side of a linear zone to provide an area for distribution of education materials.




■ Presentations (with or without videos) and training programs to a target population. If a target population congregates in zones, in-person presentations can be used in a cost effective manner.

■ Enforcement activities targeted to specific problems in the zones, for example, targeted enforcement of vehicle speeds.

### Step 7. Implement program activities

Once pedestrian safety zones have been defined and countermeasures chosen, the selected program activities must be implemented. In general, the same techniques and level of care used in citywide implementations must be applied when focusing efforts in zones. In addition, zoned countermeasures often involve door-to-door and on-street activities rather than distribution by mail. They also typically rely quite heavily on the cooperation of people and organizations within the zones for a successful outcome. As such, two special implementation issues often arise with zone applications:

- Ensuring that seasonal weather doesn't interfere with planned activities. For example, extreme summer heat and winter cold/snow may well limit walking trips. Outdoor activities (including any outdoor data collection) will be limited at these times.

- Ensuring that staff is available in the zones to perform any needed activities. The process of contacting individual agencies and organizations to ensure their willingness to display or distribute public education materials and then actually counting out and distributing the needed materials can be time consuming and very labor intensive.

### Step 8. Monitor program activities

Program activities need to be monitored to ensure that they are proceeding on schedule, reaching the intended audience and achieving the intended results. Again, staff is needed to ensure that all activities are being carried out as planned. In addition, a survey within the defined zones can be an invaluable aid in obtaining information on residents' knowledge of the program and its subject matter.

In addition to program activities, the zones themselves need to be monitored periodically since they can be fluid. For example, a zone might contain some land use (such as a trailer park) that, if removed, would remarkably change the characteristics of the zone. Or some element might be added to the zone (such as a school, hospital, restaurant/bar or senior residence) that would affect the zone definition process or how zone activities are carried out. For an ongoing, long-term effort, the basic zone definition itself might change with old zones disappearing or changing and new zones being added.

## Example of a Program that Used Zoning

The zoning process just described is not just an idea. It has been used in three different cities as part of two large-scale research projects. This section describes how the eight zoning steps were applied in Phoenix, Arizona as part of one of those studies. The study focused on reducing pedestrian crashes to seniors.

**Step 1. Select the crash problem.** The target measure was the older adult (age 65+) pedestrian crash. The objective was to reduce crashes to this population by defining zones and applying a concentration of countermeasures within them. Since age of the victim was not routinely included in the available databases, provisions needed to be made to obtain and enter these data.

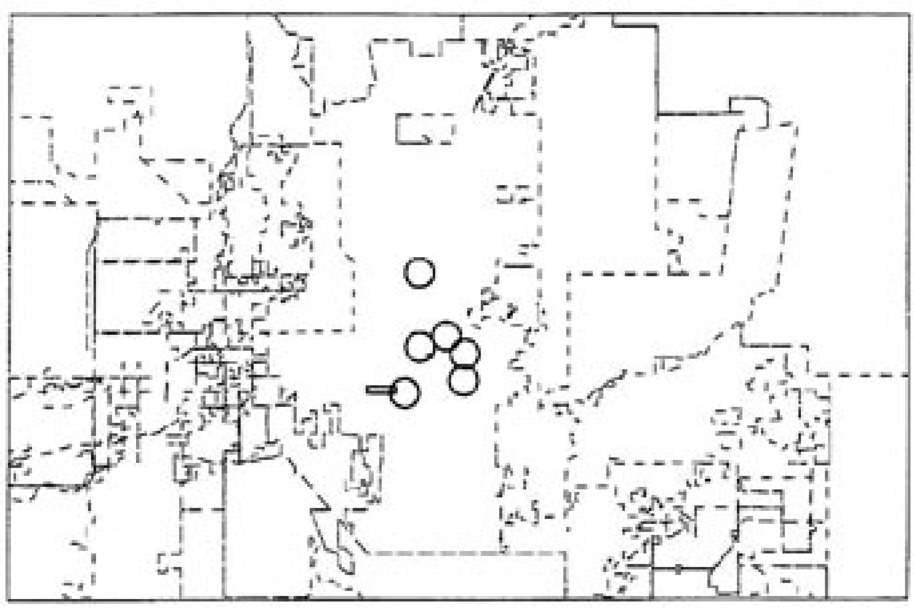
**Step 2. Map the pedestrian crashes.** Three years of baseline data provided a total of 153 older adult pedestrian crashes. The relatively small number of crashes permitted the data to be mapped manually. Colors were used to differentiate crash types.

**Step 3. Define zones.** Searches were made for circular and linear zones, and the final zones were selected.

✓ **Search for circular zones.** The standard circle with a one-mile radius was drawn on a sheet of acetate. The acetate was then moved over the map of crashes until circular areas that contained at least 10 older adult pedestrian crashes were located. Six circular zones were identified.

✓ **Search for linear zones.** The map was further examined for road segments that contained at least six crashes in a two-mile strip. One such road segment was identified as a linear zone; it partially overlapped one circular zone. One other linear zone was identified that was completely inside one of the circular zones.

✓ **Create final zone shape.** In this implementation, the circular and linear zones were retained as they seemed to provide the best fit for the mapped crashes. Three of the circular zones were, however, specifically designed to overlap slightly in order to include crashes occurring just outside the zones that would have been lost if the circles had been made contiguous.



**Step 4. Calculate efficiency measures and select final zones.** The zones selected included 54.9% of the older adult crashes in Phoenix in 4.6% of the city's land area with a resulting efficiency ratio of 11.9 to 1.

**Step 5. Evaluate zones and identify resources.** An on-street analysis of the zones resulted in identification of needed engineering improvements and resources for distribution of educational materials. Resources included libraries, homeowner's associations, senior centers and senior residences. In addition, the zone review resulted in identification of stores and small malls that could serve as locations for the collection of survey data.

**Step 6. Select program activities.** Several engineering and public information activities were mounted within the zones. Some of the engineering efforts included:

- Installation of overhead advanced pedestrian warning signs.
- Repair of pavement in pedestrian crossing areas.
- Trimming or removal of trees/shrubs and removal or relocation of signs and other impediments to sight distance.
- Installation, removal, relocation or repainting of crosswalks, as appropriate.
- Installation of signs explaining the meaning of each phase of the pedestrian signal at all intersections in and near the zones.


- Installation of a wheelchair ramp and high visibility crosswalk for the main pedestrian access point between two hospital facilities.
- Installation of "Use Caution When Entering Street" signs.
- Traffic signal timing improvements.
- Replacement of "generic" push button signs at a five-point intersection with custom signs that specify the street that each push button controls.
- Installation of a rumble strip in advance of a high-use crosswalk.

Some of the education activities performed in the zones included:

- Distribution of program flyers and brochures to homeowner's associations, retirement communities, senior centers and libraries in the zones.
- Distribution of 15 project flyers and brochures as door hangers to *each* residence in the zones. In order to accomplish this activity, the corners of the circular zones had to be convertedinto squares so that the distribution company could get precise street addresses at the zone boundaries.

These education materials included safety tips for both motorists and pedestrians. Motorists were advised to watch for pedestrians when:

- Making turns
- Passing stopped cars
- Backing

Pedestrians were advised to:

- Search before stepping off the curb
- Look carefully for turning vehicles
- Stop and look around cars, shrubs and any other objects that prevent drivers and pedestrians from seeing each other
- Look first before stepping into the street when the light turns green or the signal says WALK
- Treat driveways and alleys like roadways
- Watch for backing vehicles
- Be alert for vehicles in parking lots
- Wait for a fresh green light to get the maximum time to cross the street
- Be conspicuous at all times
- Continue crossing to the other side if the DON'T WALK signal starts to flash after they have entered the street

In addition, a broad-based *supporting* public education program was addressed to the city at large and elderly residents in the city. Included were customized television video and PSAs, radio PSAs, television and radio interviews, articles in local papers, bus cards, an article in the city's water bill mailer, and distribution of program flyers and brochures to the American Association of Retired Persons, all senior centers, city senior residences, motor vehicle offices, retirement fairs and police precincts (for the neighborhood patrol program).

In addition to the program activities, a periodic survey was conducted in each circular zone. The survey provided information on the pedestrian safety knowledge of older residents in the zones and their exposure to the highway safety program. It also served as an additional means of making older adults in the zones aware of the pedestrian safety program.

**Step 7. Implement program activities.** Because of the extreme heat in Phoenix in the summer, the major education activities and the street survey were conducted from September through May. In addition, a media consultant was retained to assume responsibility for making all local contacts for display and distribution of project materials and ensuring that all organizations received the necessary materials in the agreed-upon amounts at the agreed-upon time.

**Step 8. Monitor program activities.** On-going information on city residents' knowledge of pedestrian safety and of the program was collected by means of a survey. The survey was conducted in 10 different waves spaced throughout the program period. Police crash reports were also received and analyzed on a regular basis.  In addition, the zones themselves were analyzed on a routine basis and, except for the need to change survey locations, no changes that would affect program design or operation were noted.

Crash results from the Phoenix study show that the program was successful in reducing crashes to older pedestrians during a period when overall population in the city increased and pedestrian crashes to those under 65 years of age increased.  Decreases in 65+ pedestrian crashes occurred in each of the circular zones.  The study also showed the economy of zoning.  One of the most successful countermeasures involved three separate deliveries of flyers to each residence in the zones.  This was accomplished for approximately $24,000.  It would have cost almost 12 times that amount to deliver the flyers to each residence in the entire city of Phoenix.

## Zoning Applications

Although the sample study was concerned with pedestrian safety, the zoning technique is not limited to pedestrian crashes.  In fact, any highway safety problem or target group that can be described by the geographic location of its occurrence is fair game for zoning.  Thus, for example, the process could be applied to all types of vehicle crashes, to roadway maintenance activities, and to particular age or ethnic groups.  In fact, zoning can potentially be applied to any highway safety problem that has a mappable target measure and could benefit from more efficient program deployment.

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